



MAP Modeling and Assimilation

(GMAO Current Capabilities and Plans)

Michele Rienecker

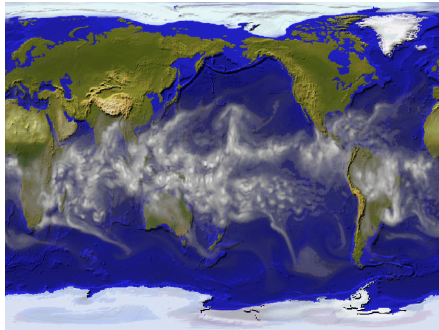
Global Modeling and Assimilation Office (GMAO)

And collaborators

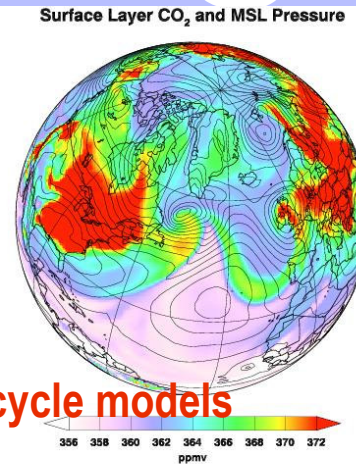
NEWS Science Team Workshop
September 7-9, 2005

MAP - Modeling Environment

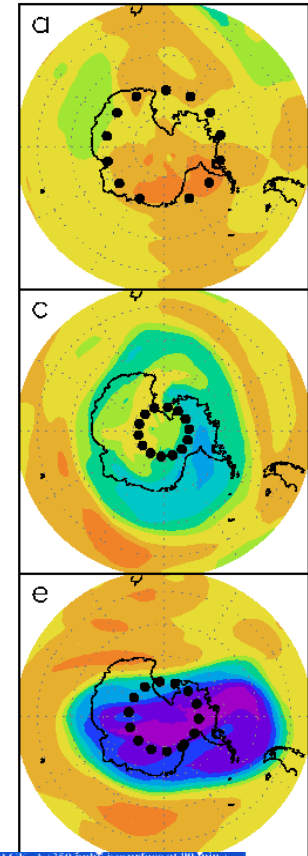
Earth System Modeling Framework



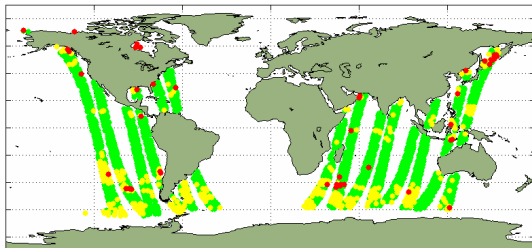
GMAO/GISS AGCM



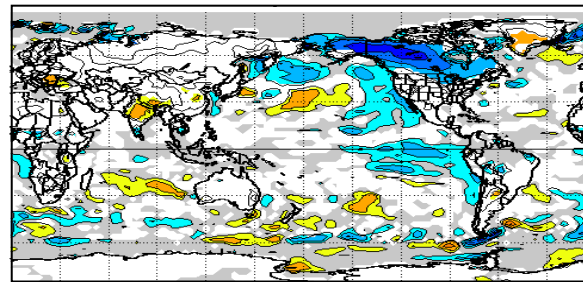
Carbon cycle models



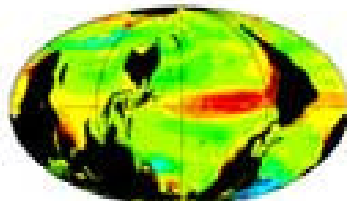
GMI



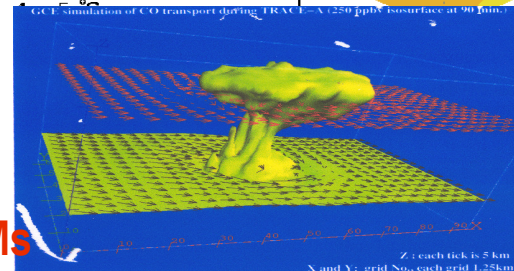
NASA/GSFC & NOAA/NCEP GSI



GMAO/GISS CGCM

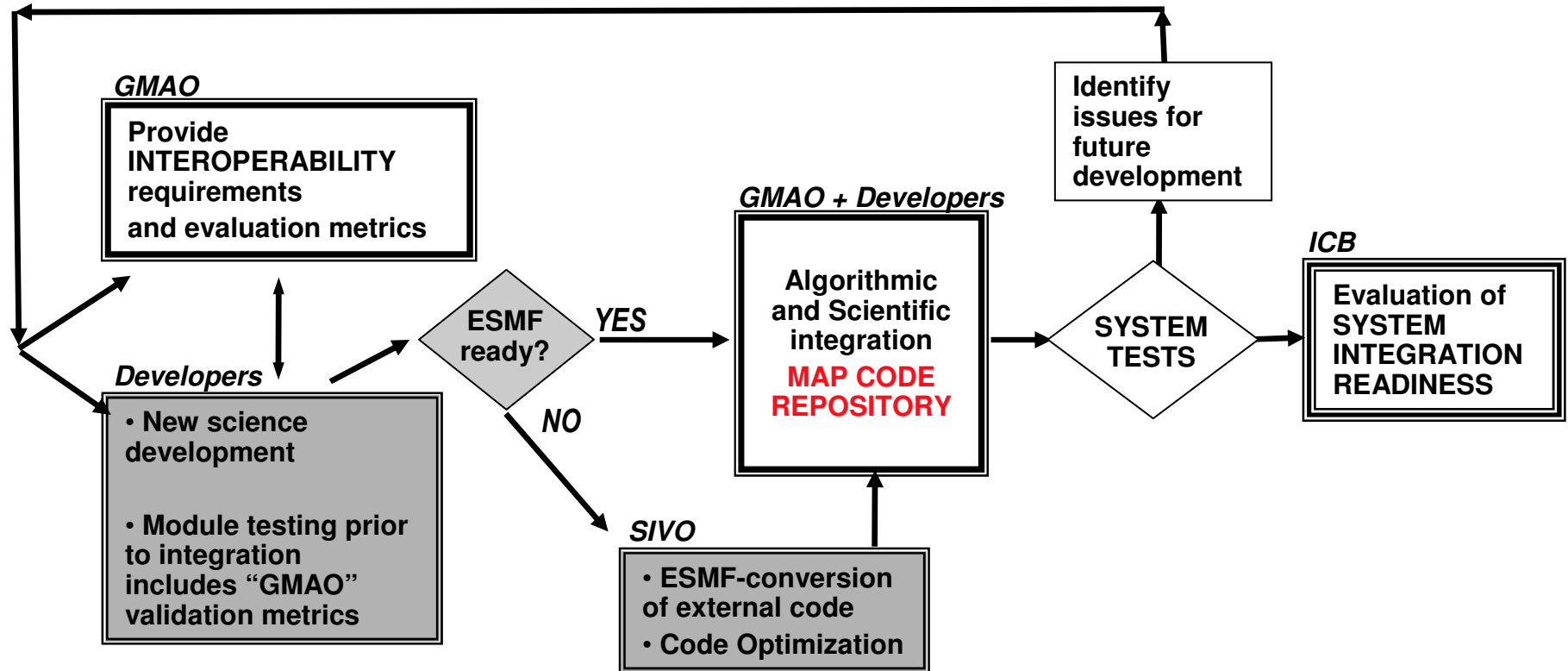


Poseidon/MOM/MITgcm



CRMs

MAP - Modeling Environment



GMAO: GMAO developers and integration team

SIVO: MAP computational support group

ICB: Integration Control Board

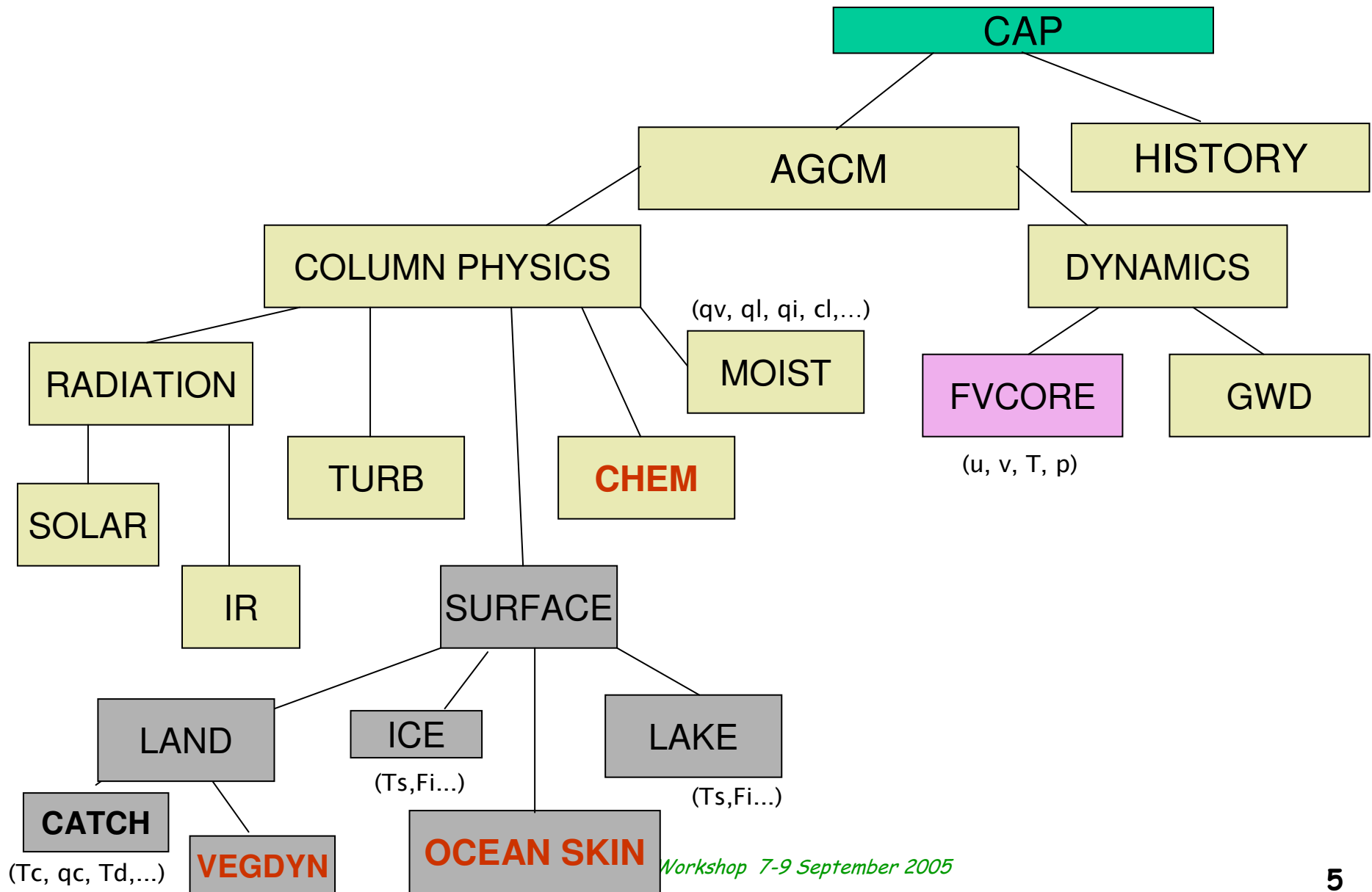
Developers: Either internal or external developers, some ESMF experts, some not



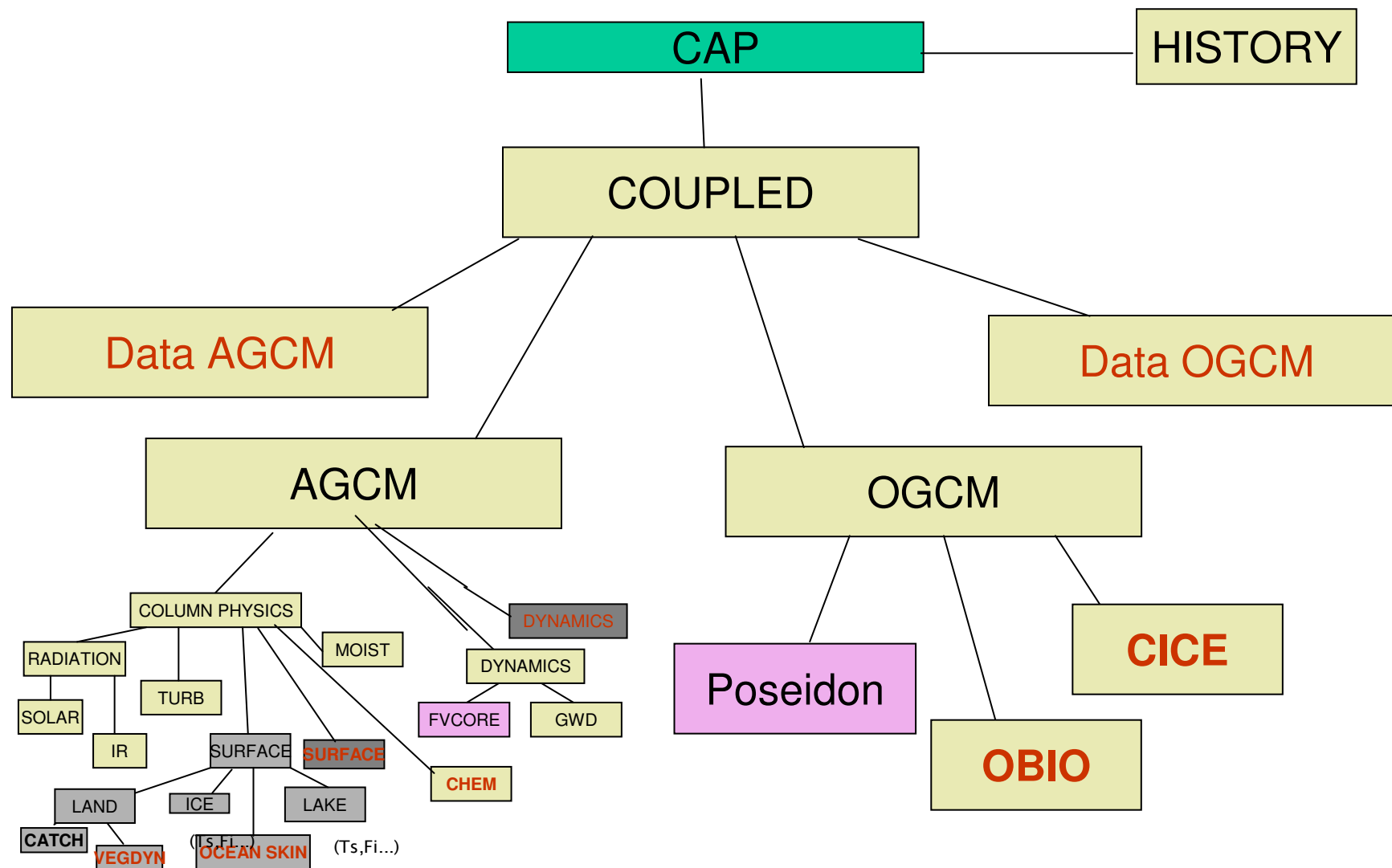
MAP - Modeling Environment

- SIVO (Head: Mike Seablom)
 - Advanced Software Technologies Group (ASTG)
 - Performance/Parallelization
 - Software engineering/design
 - Advanced scientific software - ESMF
 - State-of-the-art visualization tools and products
 - Provides shared software repository across modeling activities
 - Helps manage MAP resources
- GMAO
- GISS
- GMI
- Contributions from other SMD Focus Areas
- Collaborations

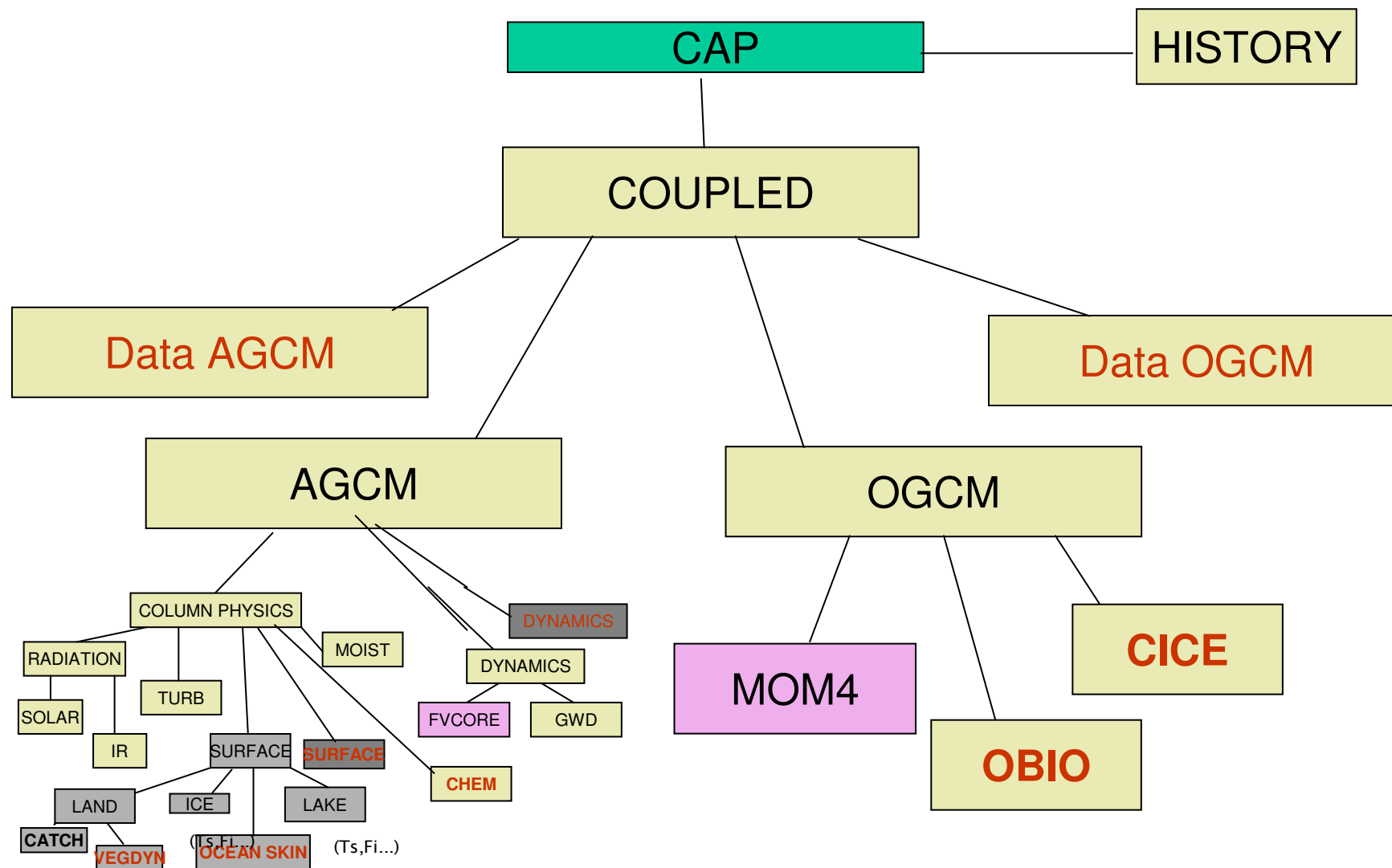
GEOS-5 AGCM COMPONENT STRUCTURE: ESMF



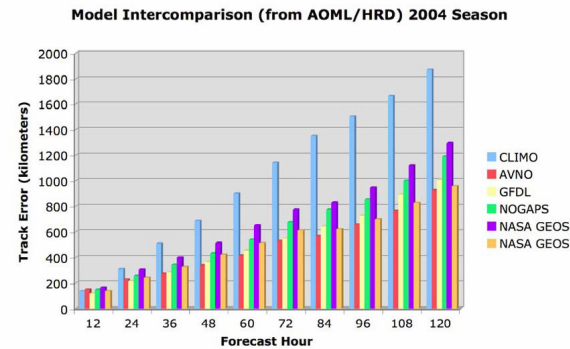
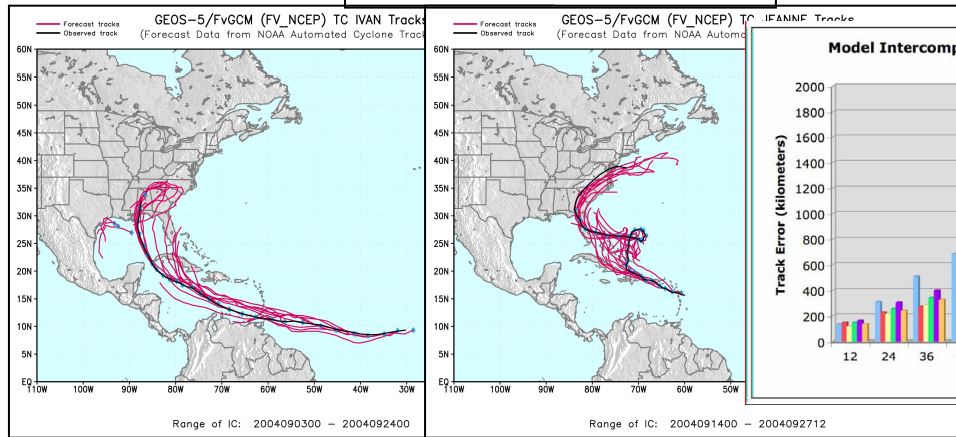
GEOS-5 COUPLED MODEL STRUCTURE



GEOS-5 COUPLED MODEL STRUCTURE

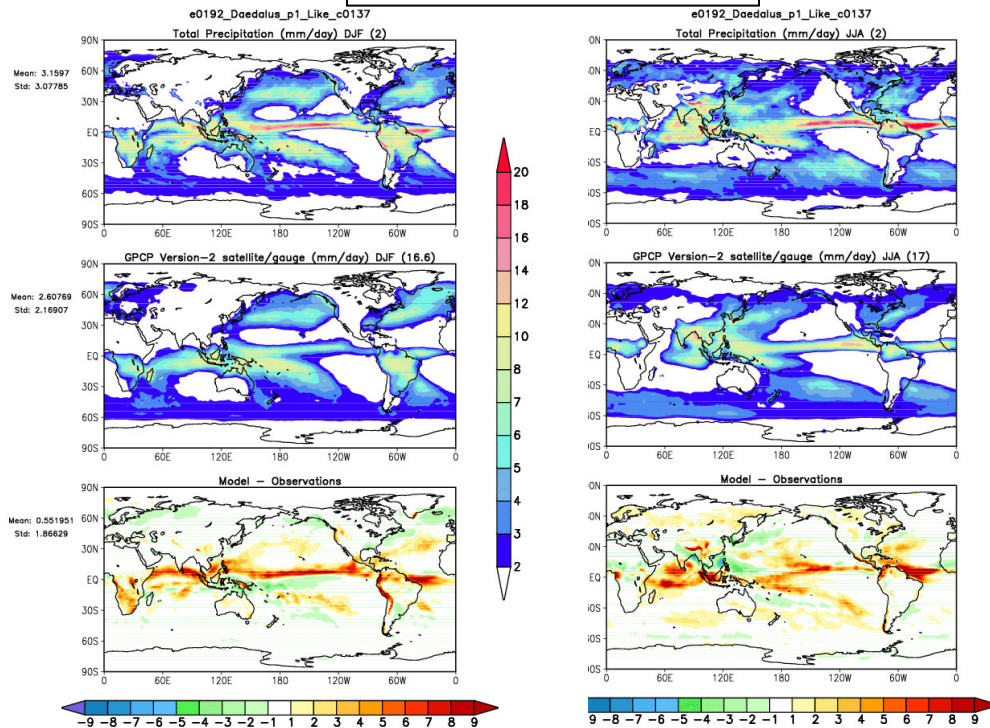


NWP mode - 1/4 degree

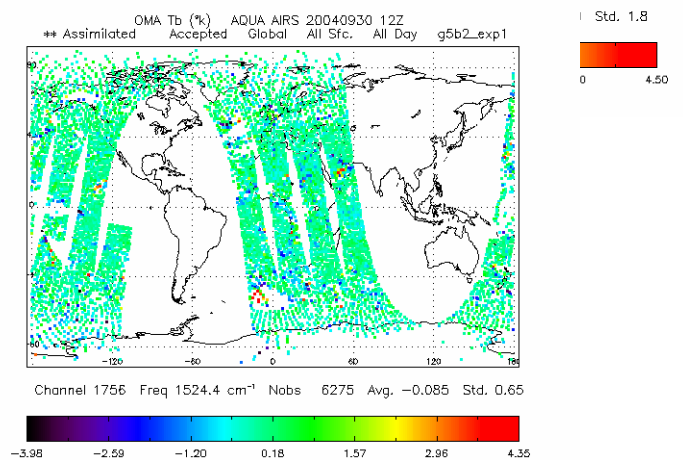
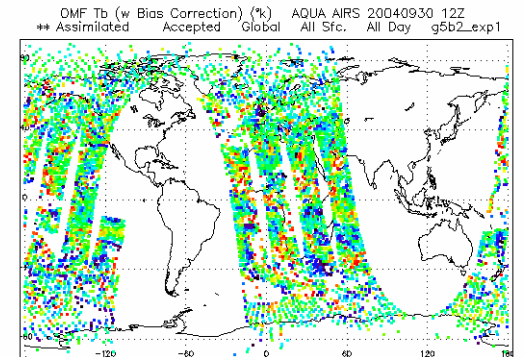


GEOS-5 AGCM TESTS

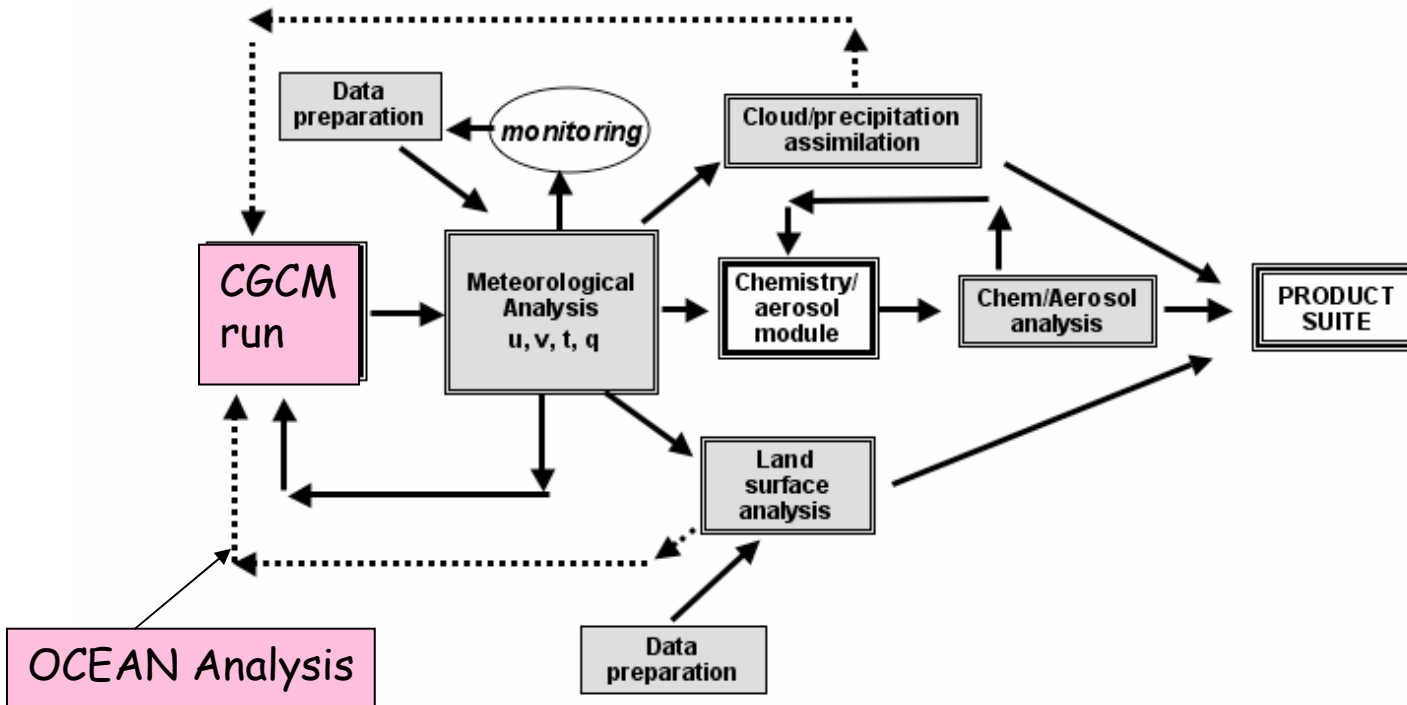
Climate mode: 1 degree



DAS mode: AIRS Assimilation



GMAO DAS




GODDARD SPACE FLIGHT CENTER

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MAP 05 Program

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- [- SATELLITE DATA](#)**
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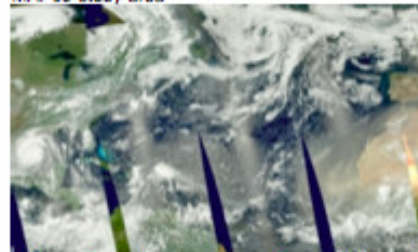



**2005 INTENSIVE ANALYSIS
PROJECT SUITE**

MODELING, ANALYSIS, AND PREDICTION PROGRAM

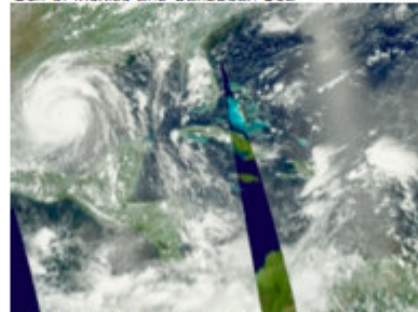
SATELLITE DATA

Aqua/MODIS 2005-07-19
MAP05 study area



[+Micro](#) [+Tiny](#) [+Small](#) [+Medium](#) [+Large](#) [+Huge](#)

Gulf of Mexico and Caribbean Sea



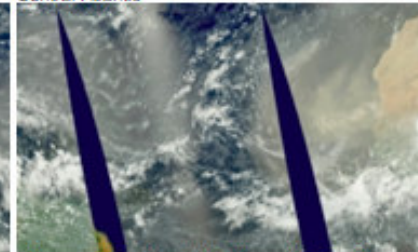
[+Micro](#) [+Tiny](#) [+Small](#) [+Medium](#) [+Large](#) [+Huge](#)

North Atlantic



[+Micro](#) [+Tiny](#) [+Small](#) [+Medium](#) [+Large](#) [+Huge](#)

Central Atlantic



[+Micro](#) [+Tiny](#) [+Small](#) [+Medium](#) [+Large](#) [+Huge](#)

Aqua/MODIS 2005-07-18
MAP05 study area

North Atlantic

SIVO - Project Office
 GMAO - G4ncep forecasts
 G5ncep forecasts
 GEOS-5 DAS and
 forecasts
 Atlas - G4ncep subproject and
 hurricane analyses
 Feldman - satellite data

 NCEP - initial data,
 vortex initializer
 diagnostics

 NAS - Columbia

MERRA

<http://gmao.gsfc.nasa.gov/merra/>

Michael Bosilovich, Siegfried Schubert & Gi-Kong Kim

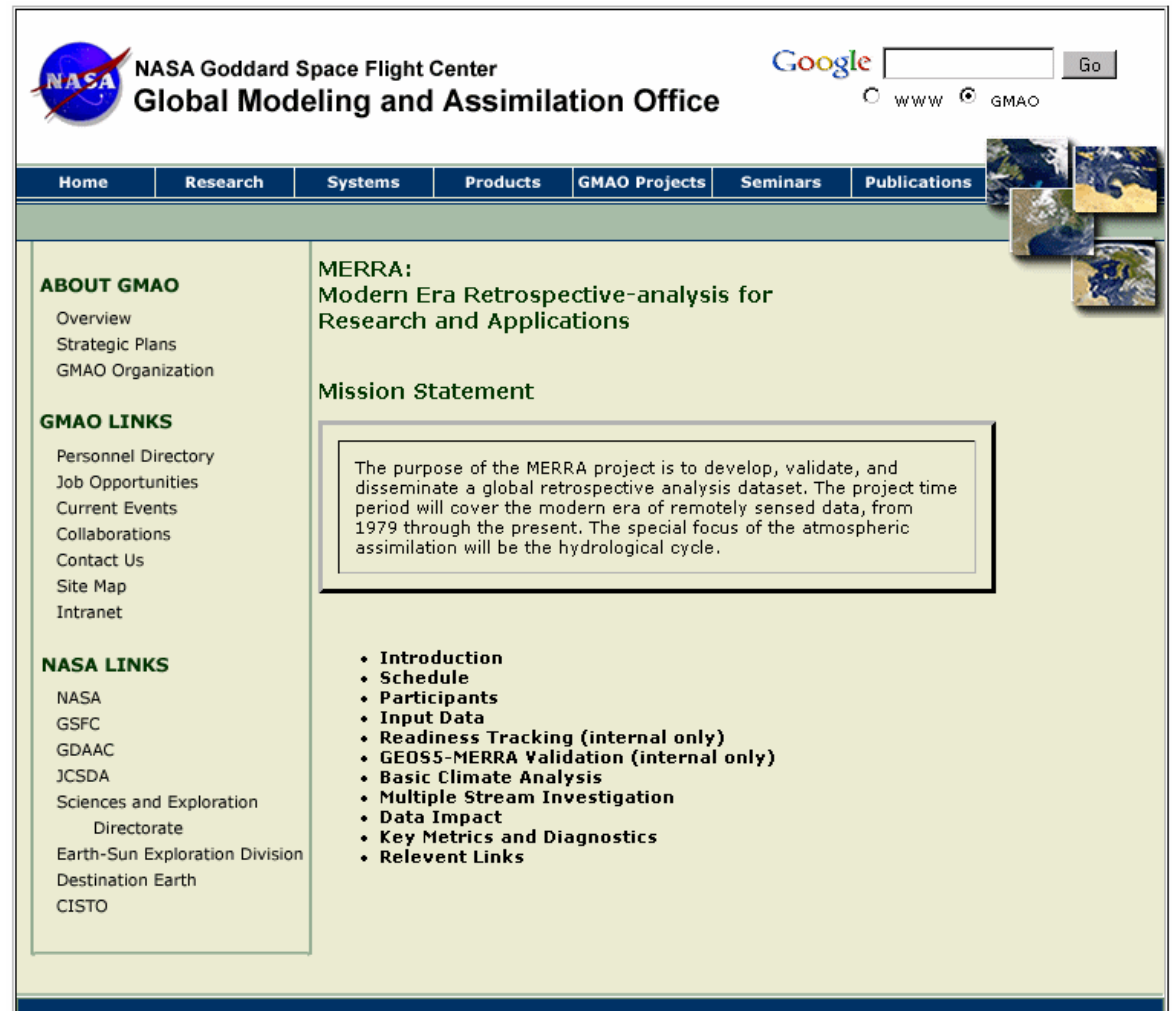
MERRA Metrics for GEOS-5

❑ WATER CYCLE

- Global Precipitation, Evaporation, and TPW
- Regional continental basin-scale budgets
- Extreme events (drought, flood)

❑ DIURNAL CYCLE

- Radiation, surface temperature
- Precipitation



NASA Goddard Space Flight Center
Global Modeling and Assimilation Office

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CISTO

MERRA:
Modern Era Retrospective-analysis for
Research and Applications

Mission Statement

The purpose of the MERRA project is to develop, validate, and disseminate a global retrospective analysis dataset. The project time period will cover the modern era of remotely sensed data, from 1979 through the present. The special focus of the atmospheric assimilation will be the hydrological cycle.

- Introduction
- Schedule
- Participants
- Input Data
- Readiness Tracking (internal only)
- GEOS5-MERRA Validation (internal only)
- Basic Climate Analysis
- Multiple Stream Investigation
- Data Impact
- Key Metrics and Diagnostics
- Relevant Links

Next GMAO CGCM - GEOS-5

Subseasonal - interannual forecasts

AGCM (NCEP or GMAO Analyses)

Atmospheric state perturbations: δ 's randomly from previous integrations; coupled breeding

Ocean state estimate perturbations: δ 's randomly from snapshots; coupled breeding

Ocean DAS (Surface wind analysis, GPCP precipitation; Reynolds SST, Temperature profiles; synthetic salinity profiles; altimetry)

9-month Coupled Integrations:
7 ensemble members, 3X monthly

AGCM: **GEOS-5 AGCM**, $1 \times 1.25 \times L72$

LSM: **Catchment LSM**

OGCM: **Poseidon v5**, $1/3 \times 5/8 \times L34$

CGCM: Full coupling, 4X per day

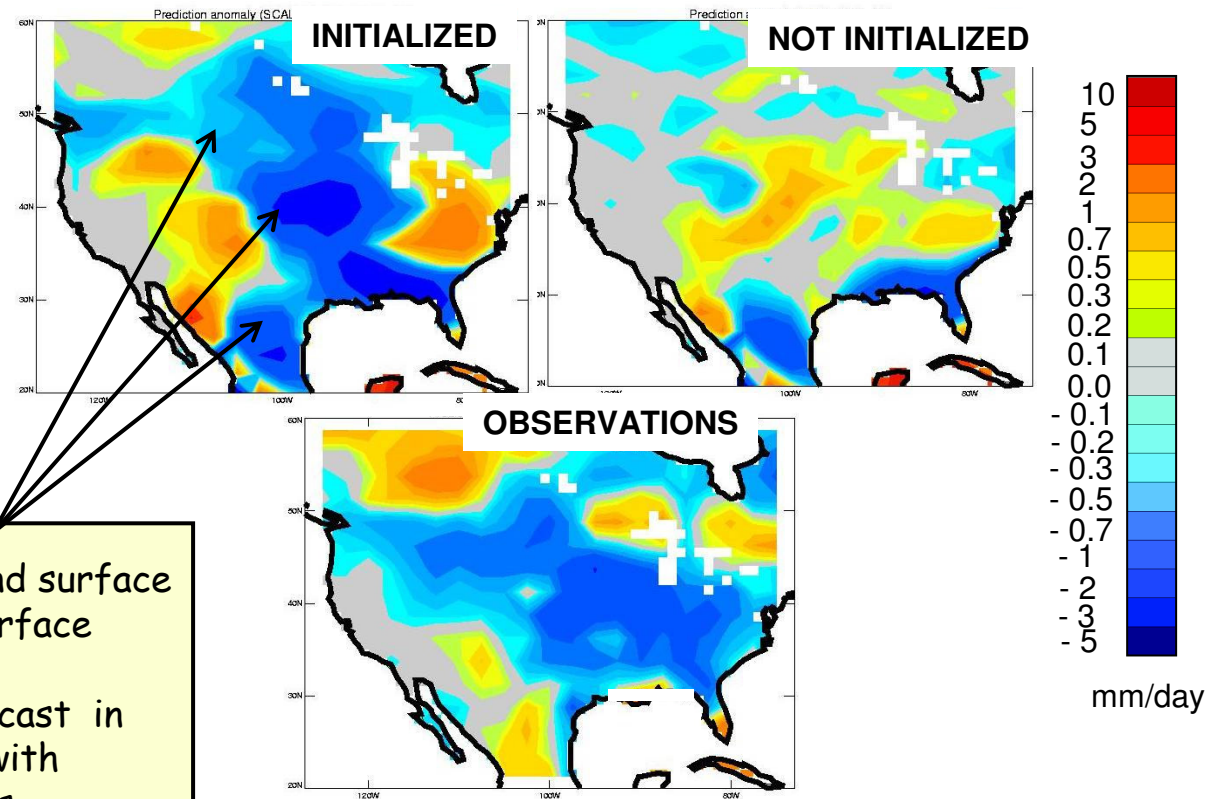
ODAS: MvOI of *in situ* temperature, salinity profiles, altimetry; Ensemble Kalman Filter

"LDAS": Offline forced land states (recalibrated). EnKF

Land surface data improves summertime forecasts of precipitation

Initializing soil moisture - preparation for HYDROS

JJA Forecast precipitation anomalies: the 1988 drought



Initializing the land surface with corrected surface forcing improves precipitation forecast in areas consistent with theoretical results

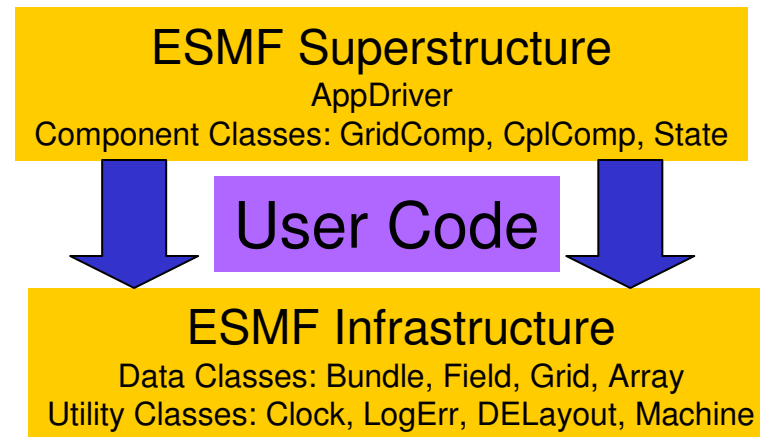
Koster & Suarez

Planned Experiments:

- ❑ 1st year: 9-month hindcasts 1993-2006;
 - 7 members, 3 times/month, coordinated with NCEP
 - 1st, 11th, 21st of the month
- ❑ 2nd year: Limited retrospective forecasts 1967-→
 - Forecasts with January starts
 - MOM4 included in ensemble
- ❑ Foci:
 - initialization of the coupled system - does breeding help? SV?
 - changes in predictability and/or forecast skill associated with changes in the ocean observing system, knowledge of surface winds, climate shifts
 - improvements in Ocean data assimilation
 - implementing Land data assimilation
 - contributing to CTB multi-model ensembles



What is the ESMF?



- ESMF provides tools for turning model codes into *components* with *standard interfaces and standard drivers*
- ESMF provides *data structures and common utilities* that components use for *routine services* such as data communications, re-gridding, time management and message logging